Space Weather Technical Forecast

Issued on Sunday, 11 December 2022 at 01:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: No Earth-bound CMEs were observed in the period. Solar activity has been Low over the past 24 hours, though with an increasing amount of long period C-class flares. The largest of these flares was a C5.4 observed at 10/1044 UTC from AR3163 near the southeastern limb. This group appears to be largely responsible for the uptick seen in X-ray activity over the last 18 hours.

There are currently eight sunspot regions on the visible disc. The largest region on the disc, AR3153, continues its slow decay and trend towards symmetry. The aforementioned AR3163 in the southeast is the second largest sunspot by area, with a large leader and several smaller trailing spots. The final larger spot group, AR3157, has simplified slightly having lost it's delta configuration. The remaining numbered sunspot regions are all small, weak and magnetically simple, and generally stable.

Solar Wind / Geomagnetic Activity: Solar winds, as observed at L1 by DSCOVR, were indicative of the waning effects of the fast wind emanating from CH53/-. The solar wind speed was elevated, but trended back to slightly elevated, ending around 470 km/s. The solar wind density was around average or below. The IMF was weak and followed a declining trend also. The phi angle was negative (towards the Sun) throughout. The net result of the above solar wind measures was for mostly Quiet geomagnetic activity (Kp 1-2), with an initial Unsettled (Kp 3) period in the 00-03 UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels.

High energy electron flux (greater than 2 MeV), as observed by GOES16, has been at Background to occasionally Moderate levels. The associated 24-hour fluence remained well below Active (1e8 integrated pfu). Observed fluence at 11/0000UTC was 1.73e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a chance of isolated M-class flares each day, currently most likely from AR3163, but AR3153 or AR3157 remain moderately large and complex. Further arriving regions into the coming UTC working week may see a further development of activity.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast. Solar wind speeds are likely to remain at Slightly Elevated levels, perhaps with a declining trend. There is a Chance of these increasing to Elevated due to an unnumbered coronal hole on day 3 (13th), before falling back to Slightly Elevated by the end of the period.

The geomagnetic forecast is therefore expected to be mainly Quiet (Kp 0-2) with a Chance of isolated Unsettled or Active intervals (Kp 3-4), mainly on day 3 (13th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels throughout, with a daily Very Slight Chance of seeing

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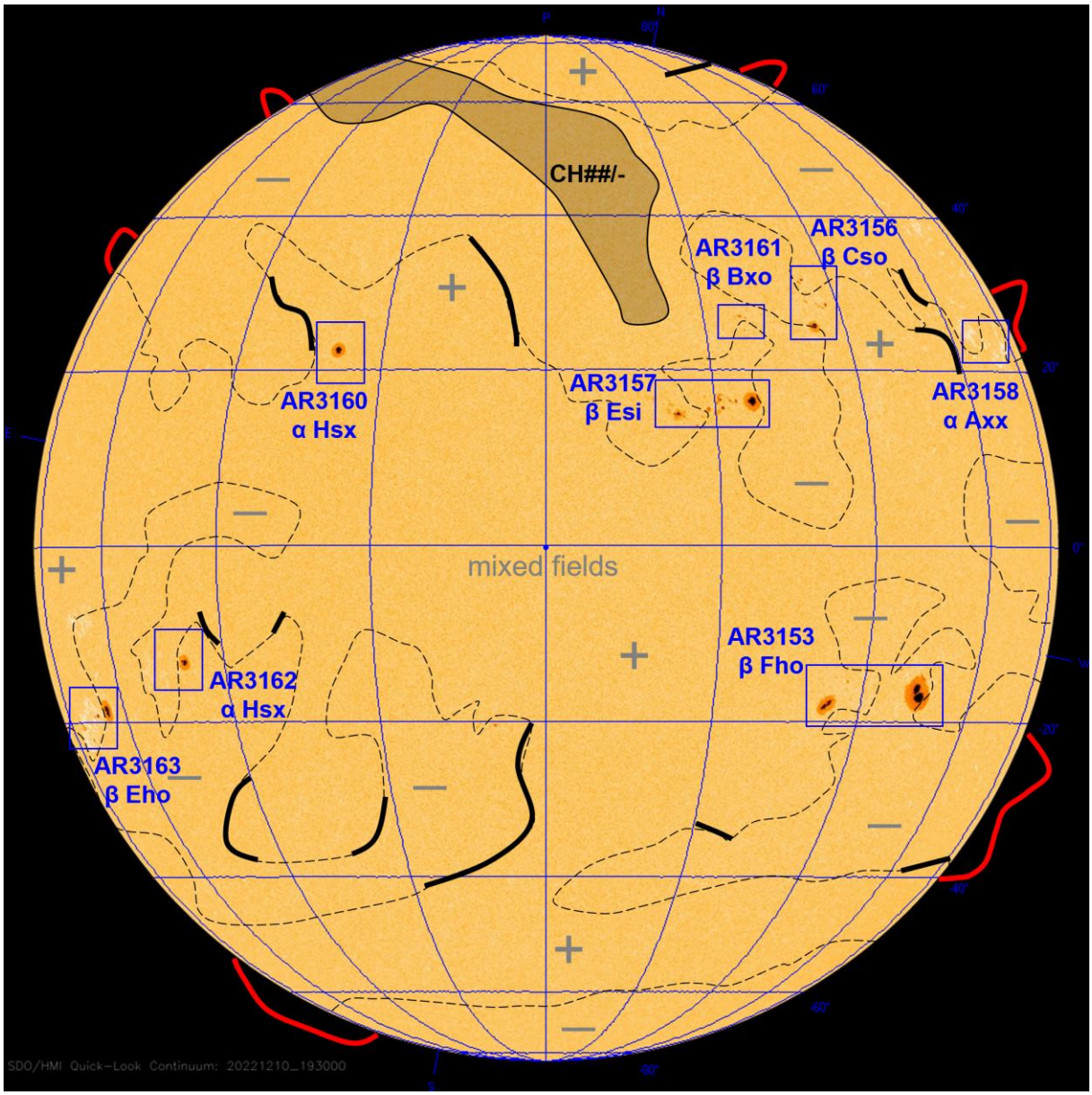
S1+ levels if any significant flares were to occur.

High energy electron flux (greater than 2 MeV) is expected to remain at predominantly Background to Moderate levels, but with an increasing trend, which brings a chance of occasional High levels (1000 pfu) being reached at times through the working week UTC. The corresponding high energy electron fluence is expected to remain below the Active (1e8 integrated flux) threshold, despite the suggested eventual upward trend.

Figure 1. Solar Analysis Valid 10/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the current forecast.

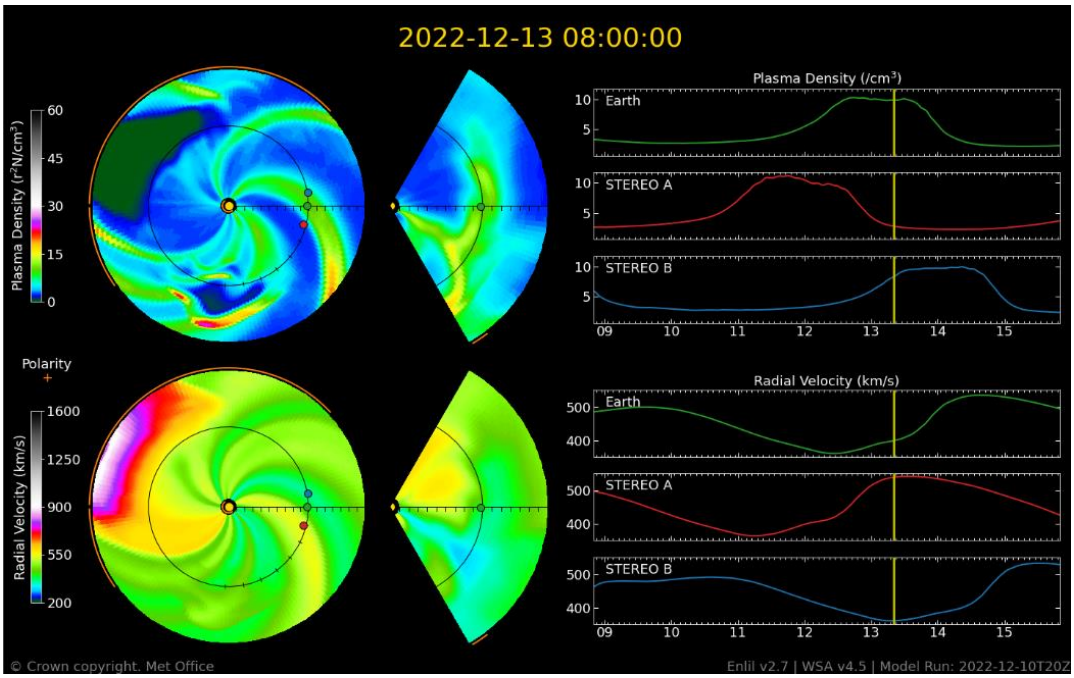
The solar wind is currently under the residual influence of CH53. Looking upwind to STEREO A, the satellite suggests the solar wind should remain at slightly elevated levels for at least the coming 24 hours (i.e. around 500km/s), but thereafter a declining trend in the solar wind speed is expected.

Both coronal hole calculations and MOSWOC Enlil then suggests that a negative polarity unnumbered coronal hole may become geoeffective through the course of the UTC day of 13 December. There was a similarly-located coronal hole present here on last rotation (13 November), however this did not produce noteworthy geomagnetic activity. This fact, coupled with our proximity to the solstice should limit any resulting effects from this feature, though a residual Very Slight Chance has been catered for within the forecast.

The geomagnetic forecast is therefore expected to be mainly Quiet with a Chance of isolated Unsettled or Active intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2:



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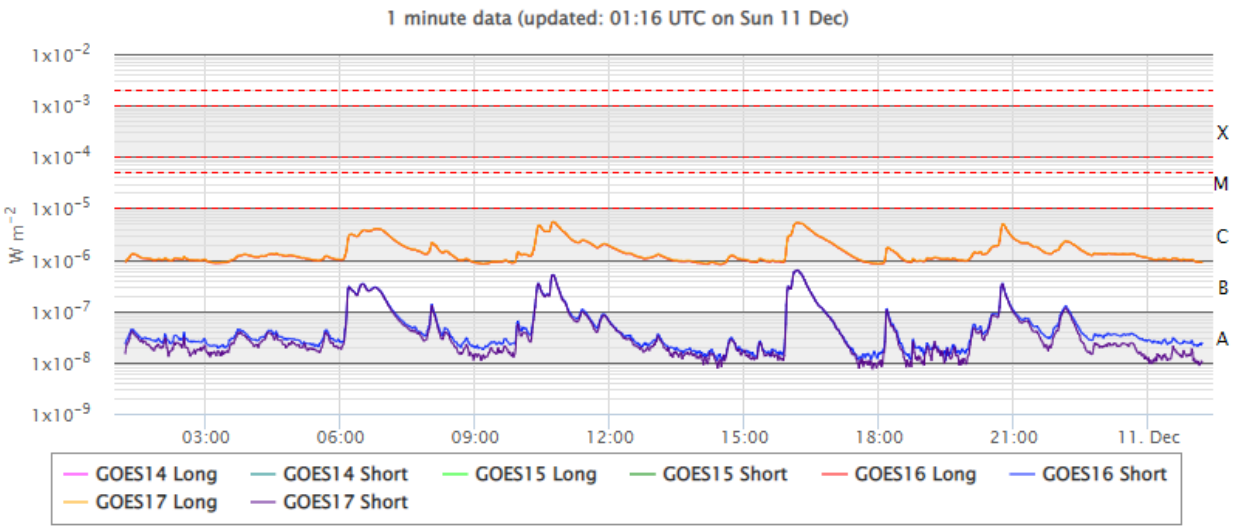
Radio Blackouts - X-Ray Flares:

There are currently eight numbered sunspot regions on the visible disc, including the newly-designated AR3163 in the southeast. This sunspot region has been the main cause of the significant observed uptick in solar activity in the past 36 hours, with a flat trace near the boundary of B and C-class flux at GOES16 giving way to occasional mid-ranking long period C-class flares and eastward-directed CMEs.

The Carrington locations for Ex-3147, 48 and 49 are all due over the eastern solar horizon into the start of the forthcoming UTC working week, and as such the probabilities of X-ray flares may increase. No significant regions leave the Earth-facing side in the four days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: 24 hour X-Ray trace



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is most likely to remain at Background levels throughout.

There remains a daily Very Slight Chance of seeing S1 or greater levels at GEO if any significant flares were to occur. The stated flat 5% risk is mainly due to the nominal presence of the three larger sunspots on the Earth facing disk. The arrival of possible significant eastern horizon sunspot groups will take some time yet to manifest on proton risks.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) is likely to react upwards to the previous Elevated solar wind speeds and ongoing HSS influence, now that the peak threat of associated geomagnetic activity has passed.

The onset of this suggested rise is now later than expected, and may also be more muted than anticipated as a result. Electrons should rise to find their level by the end of the current UTC weekend, however this now looks more likely to result in sub-Active 24-hour integrated electron fluence.

MOSWOC Enlil remains steadfast in suggesting that a new high speed stream ought to arrive sometime day 3 (13th). This hole is a negative polarity feature that extends down from the northern hemisphere towards the solar equator. This may serve to dent electron counts through the second half of the forecast period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	30	20	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM electron integrated flux/fluence forecast, persistence and observations.

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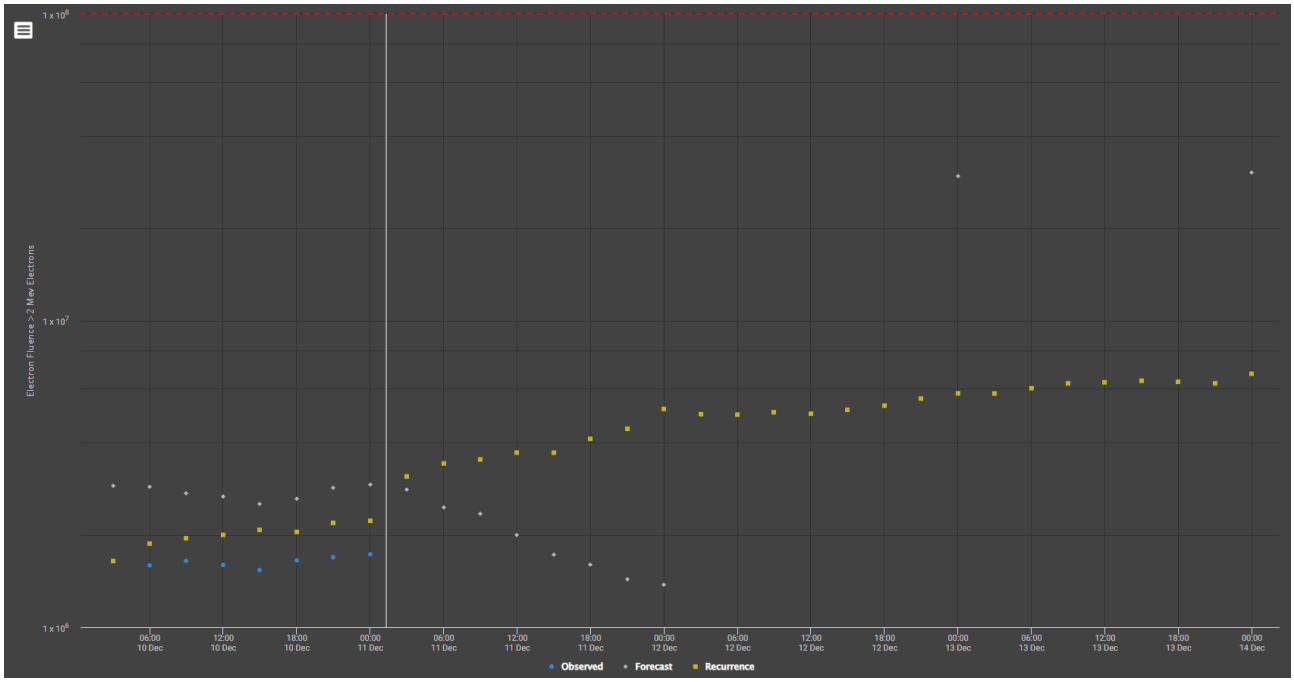

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